November 19, 2010

Mr. Dan Degan
President/Fox Run Condo Owners Association

c/o Kay Ingram
Equity Real Estate
201 Wellborn Rd
College Station, Texas 77840

Re: Report of Findings
Fox Run Condominiums – Phase 1 Foundation Repair Design
Green Engineering Consulting Project GEC10113

Dear Mr. Degan:

This report contains my conclusions and recommendations regarding repair of the foundations at the sixteen buildings located at the Fox Run Condominium Complex. This work was performed in accordance with our proposal GEC10113 dated September 3, 2010.

I very much appreciate the opportunity to provide these services to you. Please contact me if I can be of further assistance.

Very truly yours,
Green Engineering Consulting

Eric Green, PE
President

STATE OF TEXAS
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LICENSED
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Report of Findings

Fox Run Condominiums
Phase 1 Foundation Repair Design

Prepared for:
Fox Run Condo Owners Association

Prepared by:
Green Engineering Consulting
P.O. Box 3509
Sugar Land, Texas 77487

November 19, 2010

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1 Executive Summary

Based on my review of the provided documents, site observations, site measurements, training, education and experience, I have reached the following conclusions and opinions regarding post-construction movement and appropriate repairs of the slab-on-grade foundations at the Fox Run Condominiums:

1. It is my opinion that five of the buildings at the complex have or most likely have experienced excessive post-construction differential movement as defined by generally accepted standards. This includes buildings 4, 5, 13, 14 and 15.
2. It is my opinion that the differential movement of the building foundations is most likely a result of soil swelling at the building perimeters primarily driven by poor drainage and landscaping. This has not been confirmed by geotechnical testing and investigation. Given the magnitude of the proposed repairs, it is my opinion that the owners should retain a geotechnical engineer to perform a geotechnical investigation to confirm the cause of movement.
3. It is my opinion that leveling should be accomplished by complete underpinning using pressed piles or drilled piers, leaving a void space below the foundation to accommodate any future soil swelling.
4. Underpinning and leveling <u>will</u> result in distress to the interior finishes, exterior finishes and under-slab plumbing connections. Underpinning will also cause differential elevation between the building slab and adjacent flatwork at entry doors and patios. This may require removal and replacement of the flatwork to prevent trip hazards. Distress to the foundation itself is possible during the underpinning process.
5. It is my opinion that the drainage and landscaping should be remediated by removing all existing French drains, non-clay soils and landscaping. This should be replaced with fat clays and sod sloped at least 5% away from the building perimeters.

2 Scope of Services

The project is being performed in accordance with the scope of services listed in proposal GEC10113 dated September 3, 2010.

3 Basis of Report

In the course of my investigation I reviewed of the following documents:

1. Complete set of construction plans, including architectural (25 sheets), civil (17 sheets), structural (3 sheets) and landscaping (1 sheet).
2. Report of CSC Engineering ("CSC") dated September 11, 2002.

3. Report of Gessner Engineering, dated January 20, 2007.
4. Report of Gessner Engineering, dated April 18, 2008.
5. Report of Gessner Engineering, dated December 24, 2008.
6. Report of Don Illingworth dated October 22, 2009.
7. Report of EFI Global dated October 23, 2009.
8. Report of Haag Engineering dated October 22, 2009.
9. Complete set of differential elevation surveys performed by Nelson Architectural Engineers ("NAE") on September 28 through October 2, 2009.
10. Repair plan of Falkofske Engineering dated April 6, 2010.
11. Report of Robert Lytton dated September 15, 2009.
12. Draft summary of soil boring and testing results from Bryant Consultants Inc ("BCI").

I observed the interiors and exterior of various buildings and all site landscaping. I observed the site on July 27, 2009, July 31, 2009, August 28, 2009 and October 11, 2010.

If the owner is aware of any additional reports that have been issued with respect to the design or post-construction performance of the foundations, it is important that these reports be brought to my attention. Information in any such reports could impact the conclusions reached in this report.

4 Background

The Fox Run Condominiums consist of 16 buildings with substantially the same design and construction (Figure 1). The buildings are designated as Building 1 through Building 16 (Figure 2). Each building has the following generally features:

1. Each two-story building is comprised of eight units, four on the ground floor (Figure 3) and four in the second floor (Figure 4). Each second floor unit is connected to a built out attic space comprised of a bedroom, closet and bathroom (Figure 5).
2. The buildings are wood framed.
3. The buildings are primarily finished with brick veneer. Some stucco is present at the balconies.
4. The roofs are gabled and finished with composition shingles.
5. The interior ceilings and walls are finished with gypsum drywall.

Based on my review of the provided documents, I have obtained the following background information for the project:

1. The geotechnical design of the project was based on a geotechnical investigation by CSC Engineering ("CSC") dated September 11, 2002.

2. Construction of the project started circa February 2003 and was completed circa November 2004.
3. At some point after original construction was complete, the developer installed French drains along the long edges of most buildings.
4. Landscaping and drainage at Building 5 was altered circa summer 2008 in accordance with plans prepared by Gessner Engineering. This plan generally consisted of providing positive slope way from the buildings, removing planting beds and installing moisture barriers. When implementing this plan, moisture barriers were placed only along the long axes of the building to avoid damaging the AC refrigerant lines.

5 Testing by Others

5.1 Phase 1 Environmental Site Report of CSC Engineering

CSC Engineering performed a Phase 1 environmental site report dated August 29, 2002. CSC's report contained the following observations, conclusions and design recommendations:

1. Based on aerial photographs taken in 1964, the site was open pastureland with a few isolated trees observed near the center of the property. Based on aerial photographs taken in 1974, 1983 and 1994 and site observations in 2002, the landscaping characteristics of the property were essentially unchanged from 1964 through 2002.
2. Soil stockpiles were observed near the central portion of the site in 2002.

5.2 Geotechnical Report of CSC Engineering

CSC Engineering issued a geotechnical report for the site on September 11, 2002. CSC's report contained the following observations, conclusions and design recommendations regarding the site drainage and the design/construction of the slab-on-grade foundation system:

1. The majority of soils within the shallow zones at the site consist of medium to high plasticity clays which "can experience notable volume changes with even minor variations in moisture content."
2. The typical depth of seasonal moisture change in the area is typically 8 to 10 feet, but can be as high as 12 to 15 feet.
3. Select fill should consist of clayey sand or sandy clay, with a plasticity index of 7 to 18 and compacted to 95% maximum dry density (standard proctor)
4. Utility trench backfill located beneath structures should be compacted to 90% maximum dry density (standard proctor). Backfill should consist of native soils or select fill.

5. In order to prevent water from migrating along utility trenches underneath building, trenches should be sloped away from the buildings, and the use of anti-seep collars should be considered.
6. The site should be graded away from building perimeters with a minimum slope of 4 to 5% for a distance of 10 feet.

5.3 HOV Services Grade Beam Investigation

HOV Services performed a grade beam investigation in April 2009 in which test pits were dug at the perimeter of buildings 4, 5, 6, 13, 14 and 15 to determine the depth of the grade beams. HOV also recorded where water was present in the excavations. The depth of water in the excavation was recorded after 24 hours. The results of the investigation are shown in Figure 6.

5.4 Site Topography by McClure and Browne Engineering/Surveying

A site topographic survey of the area within approximately 15 feet of the perimeter of buildings 4, 5, 6, 13, 14, 15 and 16 was performed by McClure and Browne Engineering/Surveying (Figure 7) on September 2009.

5.5 Geotechnical Investigation of BCI

Extensive geotechnical testing was performed at the site by Bryant Consultants Inc. (BCI) in late 2009. This included 34 soil borings at interior and exterior locations, swell testing, suction testing, density testing and electrical resistivity testing. The results of the testing were released during the litigation in draft form only.

6 Analysis and Conclusion

Based on my review of the provided documents, site observations, site measurements, training, education and experience, I have reached the following conclusions and opinions regarding post-construction movement and appropriate repairs of the slab-on-grade foundations.

6.1 Need for Repair

Based on currently available information, it is my opinion that buildings 4, 5, 13, 14 and 15 have likely experienced sufficient post-construction differential foundation movement to justify leveling.

1. All slab-on-grade structures constructed on expansive clay soil experience some post-construction differential movement, normally driven by seasonal moisture variations, post-construction moisture equilibration and soil consolidation. The purpose of a stiffened slab-on-grade is to limit the deflection (curvature) of the slab surface resulting from any differential movement of the supporting soils such that distress to the finishes is limited to an acceptable level.

2. The most widely accepted definition of acceptable deflection was developed by the Texas Section of the American Society of Civil Engineers ("Texas ASCE")[1]. These guidelines were also adopted by the now-defunct Texas Residential Construction Commission[2] and the Foundation Performance Association[3]. They are generally compliant with recommendations of other references. Texas ASCE suggest limiting post-construction deflection to a ratio of 1/360, defined as the ratio between the length of a line connecting two points on the slab surface and the maximum offset between the line and the slab resulting from post-construction movement. Texas ASCE also notes post-construction tilt (rotation) greater than 1% is noticeable, but does not explicitly state this justifies repair. It is my opinion that these recommendations are the appropriate criteria for defining the point at which the post-construction performance of a foundation justifies repair.

3. No foundation is constructed perfectly level. The generally accepted maximum elevation tolerance for slab-on-grade construction is ± 0.75 inches. Typical real-world tolerances are ±0.375 inches. In order to calculate the deflection ratio and slope resulting solely from post-construction movement, the slab elevation at the time of construction must be known or assumed. In the present case, no post-pour slab elevation survey exists. Therefore, the post-pour elevation must be assumed. I calculated deflection ratios and slopes assuming that the slab was constructed perfectly flat[4]. It is my opinion that this analysis method is reasonable as long as the observed distress to the structure is consistent with the calculated deflection ratios.

4. Typically, foundation performance is analyzed by considering the calculated deflection and tilt as well as the extent and magnitude of distress to the interior and exterior finishes. However, I understand that at the Fox Run Condominiums there is no data available regarding past repairs to the interior and exterior finishes.
   - 4.1. Interior repairs are performed by individual tenants and no records are maintained.
   - 4.2. Repairs to the exterior brick veneer were made by the developer. At least some of these repairs are visible. The extent of any repairs which are not visible, if any, is unknown.

[1] Texas Section ASCE, *Guidelines for the Evaluation and Repair of Residential Foundations Version 2*, 2007.
[2] Texas Residential Construction Commission, *Limited Statutory Warranty and Building and Performance Standards*, 2005.
[3] Foundation Performance Association - Structural Committee, *FPA-SC-13-0 Guidelines for the Evaluation of Foundation Movement for Residential and Other Low-Rise Buildings*, July 15, 2007
[4] Assuming the slab was constructed flat gives an equal probability of under-calculating or over-calculating the actual deflection ratio and slope.

5. Based on data collected by GEC and NAE, I calculated the following deflection ratios and tilts of buildings exhibiting large total differential elevations and significant finish distress (as indicated by prior veneer repairs and/or existing finish distress):

Building	Max. Differential Elevation (inches)	Deflection	Tilt	Source
3	3 3/8	1/380	0.70%	NEA
4	3 3/4	1/375	1.20%	GEC
5	6 1/8	1/172	1.30%	GEC
13	3 1/2	1/282	0.88%	GEC
14	3 1/2	1/391	1.04%	NEA
15	5 1/4	1/258	1.35%	GEC

6. Based on the calculated deflection ratios and slopes, as well as observed and reported damage to the building finishes, it is my opinion that the foundations at buildings 5, 13 and 15 have experienced sufficient post-construction movement to justify foundation repair.

7. Based on the calculated deflection ratios and slopes, as well as observed and reported damage to the building finishes, it is my opinion that the foundations at buildings 4 and 14 have most likely experienced sufficient post-construction movement to justify foundation repair.
   7.1. Calculated deflections and/or slopes of Buildings 4 and 14 exceed accepted limits by only a small amount. Because the deflection and slope were calculated assuming the slabs were constructed perfectly flat, it is possible that actual post-construction movement does not exceed accepted tolerances.
   7.2. Based on observed distress and repairs to the finishes in conjunction with measured tilt and deflection, is it my opinion that these building have most likely experienced post-construction differential movement of sufficient magnitude to justify repair.

8. Data collected by NAE suggest that building 3 is near to acceptable limits for post-construction differential movement.
   8.1. Because the deflection and slope were calculated assuming the slab was constructed perfectly flat, it is possible that actual post-construction movement exceeds accepted tolerances.
   8.2. I have not observed the interior finishes in this building to determine if the finish distress is consistent with excessive movement.

9. While differential elevation surveys performed by NAE on the remaining buildings at the complex show that some post-construction differential movement has likely occurred at all of the buildings, it is my opinion that none of the remaining buildings have experienced sufficient movement to justify leveling or similar repairs. However,

it is my opinion that it is likely that some of the buildings will eventually experience excessive movement if the underlying cause of movement is not addressed.

10. The observed differential foundation movement is generally non-structural, meaning that the movement has not affected the structural stability of the buildings. Thus, repairs are generally not required to ensure the lift safety of the occupants. The decision to perform repairs is generally based on a desire to minimize the probability of additional movement and associated future distress, allow for repairs of exiting distress and return the floors to a flat and level condition.

6.2 Cause of Movement

In order to develop the most effective repair strategy, the cause of the noted differential movement should be understood. At the Fox Run Condominiums, it is my opinion that the most likely cause of movement is wetting of the perimeter soils and associated heaving of the building perimeter. However, this has not been verified by geotechnical testing. I recommend that a geotechnical engineer be retained to perform soil testing and verify the cause of movement.

1. Differential foundation movement on expansive clays can result from soil swelling in the high areas, soil shrinkage or consolidation at the low areas or a combination of both occurring simultaneously.

2. It is my opinion that the foundations are most likely experiencing heave as a result of soil swelling caused by an increase in soil moisture at the perimeter of the structures.
   - 2.1. SCS performed soil borings in 2002. While it is likely that the soil moisture content experienced some change by the time of construction of the building foundations, this data is the best estimate of the moisture content at that time. Soil moisture contents observed by CSC were generally well below the plastic limit, indicating a potential to swell, but relatively little potential to shrink.
   - 2.2. At most of the buildings with significant deflection, the perimeters were uniformly high or high at three of the four sides relative to the interior. This pattern was observed at buildings 3, 4, 13, 14 and 15. This pattern is consistent with heave from perimeter wetting. Of the building with significant deflection, only building 5 did not show a pattern of perimeter heave.
   - 2.3. Poor drainage was observed at the building perimeters, and water was observed in many test pits dug at the building perimeters by HOV Services in April 2009.

3. Soil settlement can occur as a result of soil consolidation (long-term compression under load) or loss of soil moisture. It is my opinion that it is unlikely that the buildings are experiencing any significant settlement.
   3.1. Settlement of the low areas can result in similar damage patterns as would result from heave of the high areas. Therefore, damage patterns alone cannot generally be used to differentiate between heave and settlement.
   3.2. Soil consolidation is largest in the areas of the heaviest loads, which occur at the perimeter of the structure. Thus, settlement of the interior relative to the perimeter is inconsistent with soil consolidation.
   3.3. There is no plausible mechanism by which the soil at the center of the foundations could dry relative to the perimeter, as this soil is protected from moisture loss by the overlying slab. This is also inconsistent with the poor drainage observed at the perimeter and water observed in test pits.
   3.4. Significant foundation settlement associated with soil consolidation is generally associated with large amounts of fill. However, the buildings with the most significant differential movement were clustered in the area of the project which received little or no fill. The buildings in the portion of the project with the largest amount of fill have not experienced significant differential movement.
   3.5. Lack of relative movement noted between the foundation and adjacent concrete flatwork is inconsistent with soil consolidation. Soil consolidation would be much smaller under the lightly loaded flatwork than under the building foundation, which would result in settlement of the foundation relative to the concrete flatwork. However, settlement from soil shrinkage (loss of moisture) would likely result in similar settlement of both the flatwork and foundation.

4. I performed a <u>preliminary</u> review of the raw data and testing collected performed by BCI.
   4.1. Due to the enormous amount of data collected and testing performed, a complete in-depth review of the information is well beyond the scope of work for this phase of the project.
   4.2. My preliminary review of the data revealed no clear support any specific cause of movement at the site (heave or settlement) with the possible exception of deep seated heave at the perimeter.

5. <u>Given the magnitude of the proposed repairs, it is my opinion that the owner should retain a geotechnical engineer to develop an opinion on the cause of movement.</u>
   5.1. My ultimate recommendations regarding which buildings should be leveled and how the buildings should be leveled is generally independent of causation (heave or settlement). However, if the geotechnical investigation determines that the cause of movement is solely or primarily soil shrinkage or

consolidation, this has significant implications with regards to the extent of landscaping remediation required at the project, as well as grouting of voids caused by lifting. This could result in significant cost savings to the owner.

5.2. As part of the geotechnical investigation, the geotechnical engineer will be able to provide geotechnical guidance for the repair design, such as minimum pier depths, recommendations regarding grouting of void spaces and backfill recommendations.

5.3. Extensive geotechnical testing was performed at the site BCI. This data can be used by the geotechnical engineer performing this part of the work. However, the engineer may wish to perform additional confirmatory borings or testing. The final scope of work will have to be developed in conjunction with the geotechnical engineer selected to perform the work.

5.4. I suggest that strong consideration be made to retaining BCI for this project due to their extensive site-specific experience. I discussed this possibility with Mr. John Bryant, president of the firm. Mr. Bryant indicated that since the lawsuit has settled, he did not believe that there would be a conflict of interest for him to perform additional work for the owners association. Using BCI to perform this work should be highly cost effective relative to hiring a new firm with no site specific experience. I have worked with them in the past on other projects and BCI enjoys a good reputation for work in the area of expansive clays.

6. It is my opinion that groundwater flow may be a contributing factor to the noted movement.

6.1. Prior to development, the Fox Run site sloped from the east to the west, with an elevation drop of approximately 8 feet across the site.

6.2. The buildings experiencing unacceptable foundation movement are clustered at the east corner of the site.

6.3. CSC reported sand seams at the site, as well as clayey sand strata. Sand seams and clayey sand strata can transmit groundwater. However, no groundwater was reported by CSC.

6.4. It is possible that groundwater flow through these layers is a contributing factor to the noted heave. Groundwater flowing from the higher off-site elevations to the east would first impact the buildings at the east corner.

6.5. A groundwater analysis is outside of my scope of work. If the owner is interested in investigating this possibility, a qualified geotechnical engineer of hydrogeologist should be retained.

6.6. My preliminary review of the BCI data indicates that it is unlikely that groundwater is a contributing factor to the movement, as no groundwater was observed in any of the borings.

6.3 Repair Methodology

It is my opinion that that the buildings should be repaired by full underpinning, leaving a void in place under the foundation after lifting.

1. Generally, three options are available for leveling of the foundations; underpinning, mudjacking and urethane injection.
   - 1.1. Underpinning consists of installing piers or piles under the foundation and supporting the foundation on the underpinning. The most common methods of underpinning include driven segmental concrete piles, driven segmental steel piles, drilled concrete piers and helical steel piles.
   - 1.2. Mudjacking consists of the injection of cement grout under the foundation. The pressure of the grout lifts the foundation to a level condition. Grouting under low pressure can also be used to fill the voids present after the foundation has been lifted using conventional underpinning techniques.
   - 1.3. Urethane injection is similar to mudjacking except an expanding polyurethane foam is used instead of cement grout. Urethane injection is more controllable than mudjacking.

2. I recommend that the foundations be underpinned and lifted to a level condition.
   - 2.1. Mudjacking and urethane injection is generally inappropriate for leveling multistory structures or structures with large perimeter loads such as brick veneer buildings. It is my opinion that mudjacking and urethane injection are unlikely to work successfully at this project.
   - 2.2. Mudjacking and urethane injection can re-level buildings. However, the structure will remain a ground supported structure and will experience movement as a result of any future changes in soil moisture or soil consolidation.

3. It is my opinion that installation of underpinning by tunneling is generally preferable to installation from the interior using breakouts. However, it is my opinion that bids should be obtained for performing the repairs from both the interior and by tunneling before a final decision is made by the owner.
   - 3.1. Underpinning can be installed from beneath the foundation by tunneling, or from inside the building by making concrete breakouts in the slab.
   - 3.2. Installing underpinning from the interior is generally cheaper than tunneling, but requires the ground floor to be completely vacant during the performance of the work, and requires removal of all floor finishes. Underpinning from tunnels can generally be performed while the building is occupied.
   - 3.3. For post-tensioned concrete foundations, as used at the Fox Run complex, concrete breakouts have several undesirable characteristics. First, post-

tensioning tendons can accidently be cut when breakouts are made[5]. Second, the concrete breakouts result in a minor reduction in the structural capacity of the foundation.

4. In theory, partial underpinning can be installed, lifting only the low areas to the elevation of the high areas. This repair method was suggested by Falkofske Engineering. However, I recommend that full underpinning be used at the Fox Run project.
   4.1. Differential elevation patterns at the buildings generally extend over the full area of the foundations and would require installation of piers over the vast majority of the building area even if partial underpinning was used.
   4.2. Partial underpinning creates the possibility of distress from compatibility stresses, which result when the slab-on-grade portion of the foundation, which floats on the supporting soil, exhibits differential movement relative to the underpinned portions of the foundation, which are fixed. This can result in distress to finishes at the interface between the ground supported and pier supported portions of the foundation.
   4.3. Full underpinning allows the option to "overlift" the foundation such that the full area of the slab is lifted off the supporting soil and the foundation is supported solely on the underpinning. This prevents movement from future soil swelling which could otherwise occur in the portions of the foundation supported on the soil, as long as the amount of swelling is less than the depth of the void space.
   4.4. Partial underpinning will perform acceptably if the moisture content if the supporting soil is stabilized and no significant soil movement occurs after underpinning is complete.
   4.5. If the movement is fully or partially a result of soil shrinkage, or if soil shrinkage occurs in the future, full underpinning will prevent differential movement of the foundation whether the void space is grouted or not.

5. Lifting of the foundation will result in a void space below the foundation. Some engineers prefer to leave this void in place to allow for any additional soil heave that occurs after the lifting has been completed. This approach was advocated by Illingworth and Falkofske in their repair proposals. Other engineers recommend that the void space be grouted. It is my opinion that at the Fox Run project, leaving a void space under the foundation is more likely to lead to successful future performance of the foundation. However, this decision should be made after consulting with the geotechnical engineer and repair contractor (this decision may impact any warranty offered by the contractor).

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[5] The locations of the tendons can be determined prior to creating the breakouts using non-destructive testing techniques.

5.1. The primary argument for leaving a void space under the foundation is that this provides protection against future soil heaving. Generally, the foundation is "overlifted" to provide a minimum gap between the foundation and soil. Given that the movement at Fox Run is most likely a result of soil heave and it is unlikely that any drainage and landscaping remediation will completely prevent future increases in soil moisture, it is my opinion that leaving a void space is important to minimize the probability of future movement.

5.2. Leaving a void below the foundation provides an avenue for water and vermin to migrate throughout the building footprint. Grouting after lifting reduces water and vermin mobility. If not grouted, the void space below the grade beams should ideally be drained as noted by Illingworth. However, it is my experience that it is impractical to provide such under slab drainage. This would require tunneling along every grade beam, and surveying the backfill to ensure adequate slope. Even if such drainage could be installed, it is impossible to maintain. The presence of a void space can lead to severe heave, moisture migration through the slab and vermin problems.

5.3. While the post-tensioned foundation is designed to span over void spaces resulting from soil movement, the distance which can be spanned is relatively small and the foundation is not designed to span between grade beams. Grouting provides full support for the slab-on-grade foundation at the time of grouting. However, even if the foundation is grouted after underpinning, the foundation is likely to become fully pier supported in any areas where soil shrinkage occurs as a result of a future reduction in soil moisture.

5.4. The greatest advantage to grouting is that it provided full support in the areas where restraint-to-shrinkage cracks exist, such as in Building 5. Restraint to shrinkage cracks are created where the post-tensioning force in the foundation is inadequate to overcome the resistance provided by the grade beams embedded in the soil and is unable to close cracks caused by concrete shrinkage. In these areas the foundation is effectively unreinforced. However, these areas can also be effectively repaired by the installation of additional underpinning on either side of the restraint-to-shrinkage cracks.

5.5. It must be understood by the owner that if the foundation is repaired by underpinning and the voids are grouted, this repair offers no protection against future soil heave. If the soil under the building gains moisture and swells, the foundation will heave off of any underpinning. This repair will provide long-term success only if the soil moisture under the building is stabilized.

6. Lifting of the foundation will result in damage to the interior and exterior finishes as well as plumbing connections.

6.1. Damage is likely at the plumbing connections. The water and sewer lines must be tested after lifting and repaired as needed. This will require tunneling to the locations of damaged lines. If the foundation is underpinned by tunneling, it is likely that only a small amount of additional tunneling will be required.

6.2. Leveling of the foundations will result in damage to the interior and exterior finishes. This will be especially severe in areas where repairs have been previously made. Leveling of the foundation will act to close cracks created by foundation movement. In areas where previous cracks have been patched, this will result in compression and crushing at the patches. In areas where masonry repairs have been made (Figure 8, Figure 9 and Figure 10), cracks will form in nearby locations. Given the extent of repairs in the finishes, this will likely result in extensive cracking of the brick veneer.

6.3. Lifting will result in large differential elevation between the building foundation and adjacent concrete flatwork in some areas. It is likely that some of the sidewalks will have to be broken out and re-poured at the patios and front entries.

6.4. Lifting can result in fracture of the grade beams and slabs. This is most likely to occur in areas where restraint-to-shrinkage cracks are located. This may require the installation of additional piers and areas of failure.

6.5. Installation of piers will damage the under slab vapor barrier. This can cause problems if moisture sensitive floor finishes are installed in the future. In some case this can also lead to mold growth on interior finishes in the area of damage.

6.4 Drainage and Landscaping Remediation

As previously discussed, underpinning of the foundations will not prevent future movement from soil swelling. Therefore, I recommend that significant changes be made to the site landscaping to reduce the probability of future increases in soil moisture at the building perimeter due to rainfall and irrigation.

1. My personal observations and site topography taken by McClure and Browne confirmed that the site grading and drainage at the immediate perimeter of the buildings generally does not conform the to the 5% slope required by the building code.
   1.1. Planting beds are commonly constructed with berms, trapping water against the building perimeter.
   1.2. Planting beds are commonly constructed with metal edging, which traps water in the beds.
   1.3. Some beds have trapped drainage from sidewalks which are elevated above the soil elevation.
   1.4. Many sodded areas and planting beds have no slope, and many have less than the 5% slope away from the building.

2. It is my opinion that the landscaping should be remediated to improve site drainage at Units 1, 2, 3, 4, 5, 12, 13, 14, 15 and 16. It is my opinion that these buildings have experienced significant differential movement from soil moisture entering at the building perimeter.

3. It is my opinion that the owner may reasonably consider delaying improvements to the perimeter landscaping at buildings 6, 7, 8, 9, 10 and 11. However, this decision should only be made with the understanding that the structures should be regularly monitored for evidence of significant differential movement.
   3.1. The magnitude of differential elevation at these buildings is relatively small compared to the remaining buildings. Buildings 6, 7, 8 and 11 all have between 2 1/8 and 2 1/4 inches of differential elevation, and buildings 9 and 10 have between 1 1/8 and 1 1/4 inches.
   3.2. It is possible that these building will continue to exhibit acceptable performance in the future. However, given the magnitude of movement observed at other buildings with similar foundation design, soil, drainage and landscaping, it is also possible that they will eventually experience excessive movement.
   3.3. If landscaping and drainage improvements are delayed at these buildings, the interior and exterior finishes should be monitored for signs significant differential foundation movement. If significant distress consistent with differential foundation movement is noted, the condition should be evaluated by a competent engineer.

4. French drains have been installed on the majority of the building perimeter. It is my opinion the drains should be removed.
   4.1. Unless properly designed and carefully installed, French drains can result in water entering into the soil instead of removing water.
   4.2. Based on a lack of concrete stains at the drain outlets, it is clear that many of the drains are not properly functioning. It is likely that the drains in these areas are storing water which percolates into the soil at the building perimeter.
   4.3. The areas where the drains are removed should be backfilled with compacted fat clay.

5. Drainage and landscaping should be modified with the goal of maximizing the drainage of water away from the building and minimizing movement of water into and out of the soil at the perimeter of the building.
   5.1. The foundations were generally not constructed with sufficient elevation above the adjacent concrete flatwork, including sidewalks and parking areas, to allow from proper development of drainage away from the building (Figure

11). The building code requires a minimum slope of 5% away from the building for a distance of 10 feet

5.2. The most effective method of remediating the perimeter drainage and landscaping is to install a concrete apron around the full perimeter of the building, sloping away from the building and extending outward a distance of 5 to 10 feet. This apron would stabilize moisture under the building by preventing movement of water into or out of the soil under the building. One advantage of the installation of a concrete surface at the building perimeter is that proper drainage can be accomplished with less slope than required for an unpaved area, 1% instead of 5%. I recognize that this option is unacceptable to most owners due to aesthetic concerns.

5.3. The second most effective method of improving landscaping and drainage is to remove all landscaping beds from the perimeter of the building, including existing planting mix. Existing soil in the planting beds should be removed down to the level of the native clays and backfilled with compacted fat clay. The area should be graded with a 5% slope away from the buildings perimeter and sodded. Remediation of the site will require the installation of surface drains around the perimeter of the building. Effectively speaking, this will generally require the creation of a shallow moat around the perimeter of the buildings with surface drains at the bottom of the trench (Figure 12). This is similar to what has already been done at building 5 (Figure 13).

6. It is my opinion that the owner should consider leaving all areas at the perimeter of the building fully sodded with no planting beds.

   6.1. Even with proper slope on the surface, permeable planting soils at the beds can result in trapped water reservoirs which slowly permeate into the clay soils below (Figure 14). This is exacerbated if automatic sprinkler systems are installed which keep the soil wet.

   6.2. Sod can be planted directly on fat clay soils without the presence of permeable planting soils.

   6.3. If planting beds are installed, they should be building upward on top of a layer of impermeable clay which slopes 5% away from the building.

7. If review by a geotechnical engineer determines that the cause of movement is unrelated to moisture entering under the foundation from surface water at the building perimeter, landscaping remediation will need to be re-evaluated.

7 Future Performance

Regardless of what repairs and landscaping remediation is performed, the owner must accept that future performance of the foundation cannot be guaranteed. The recommendations in this report will only serve to reduce the probability of excessive future movement of the foundations.

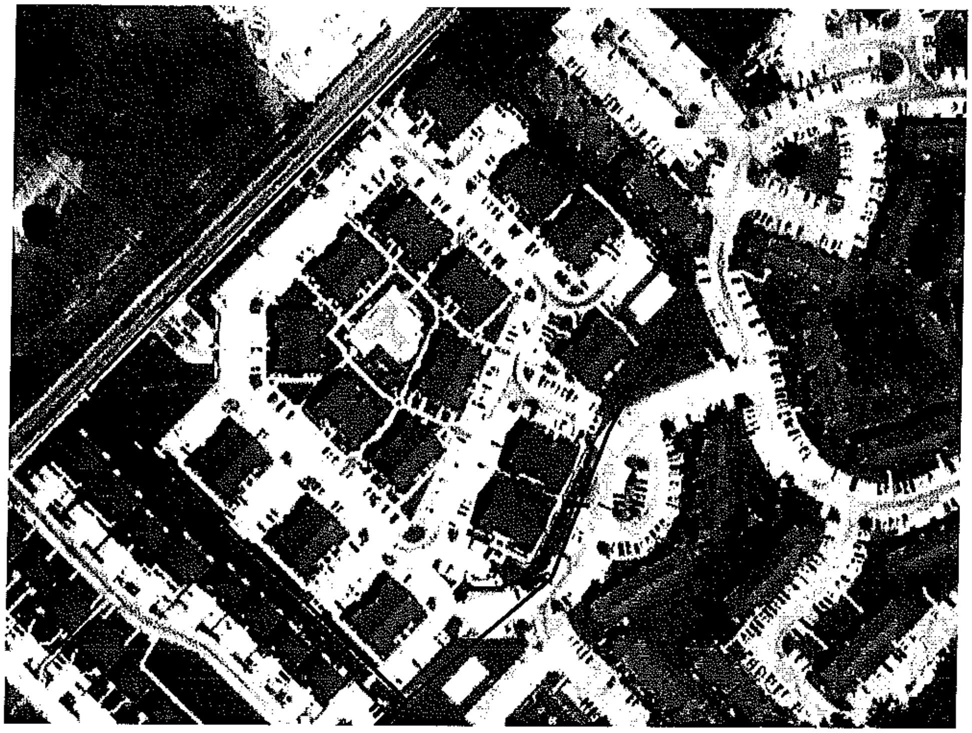

Figure 1 – Site layout (Aug 2006 photo).

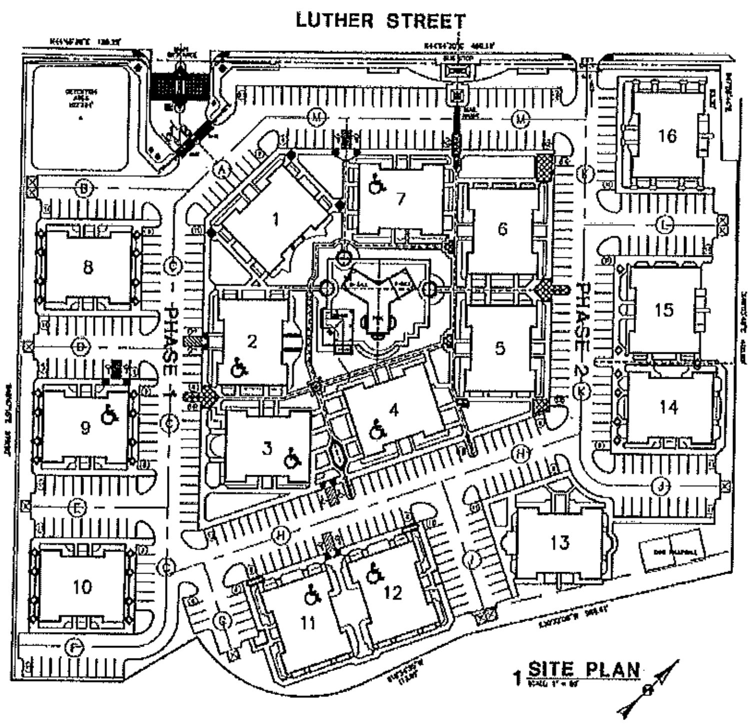

Figure 2 – Building designations.

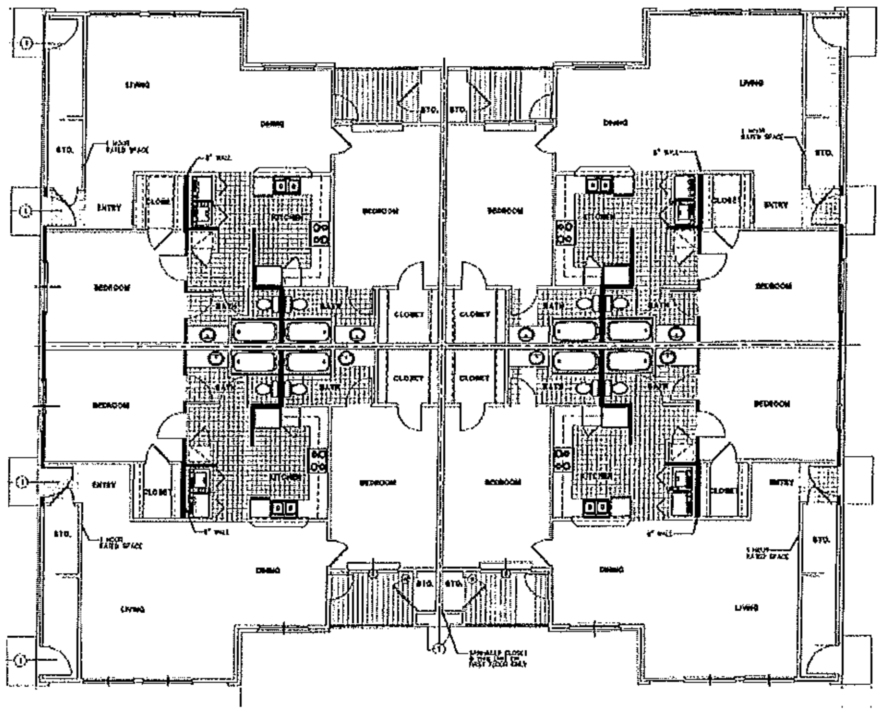

Figure 3 – Ground level floor plan.

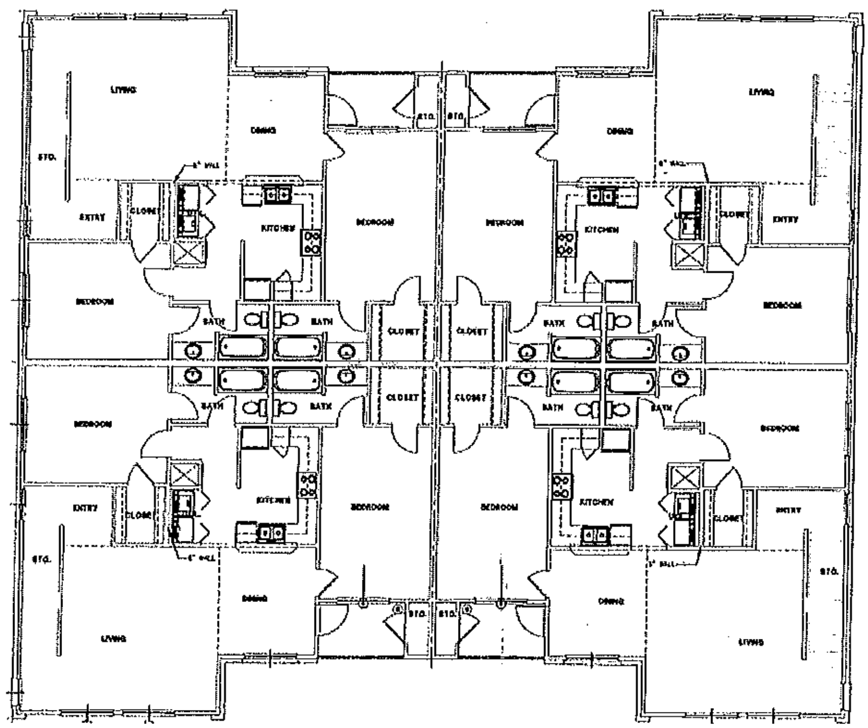

Figure 4 – Second level floor plan.

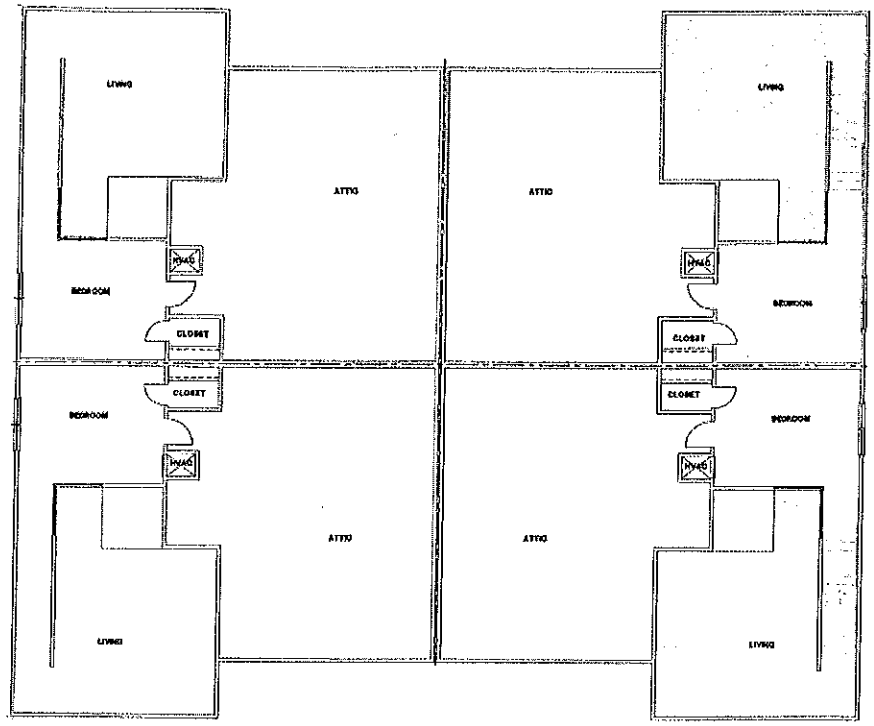

Figure 5 – Attic floor plan.

Fox Run Condos
4/23/2009
By: HOV Services LLC/Meridian

EXTERIOR GRADE BEAM INVESTIGATION

* Depth was measured from bottom of brick ledge to the bottom of the exterior concrete grade beam; therefore the numbers listed below have 1.5" added. When water was present in the hole, the measurement shown is from the bottom of the excavation, which is approximately the depth of the grade beam. The water depths were measured the next day on 4/24/09.

* dimension in inches

Location Index		Grade Bm. Depth	Water Depth		Location Index		Grade Bm. Depth	Water Depth
4.1	27	28.5			4.5	29	30.5	
4.2	27	28.5			4.6	32	33.5	
4.3	28	29.5			4.7	29	30.5	
4.4	30	31.5			4.8	30	31.5	26.75
					4.9	29	30.5	
5.1	30	31.5			5.7	27	28.5	22.5
5.2	29	30.5	26		5.8	28	29.5	
5.3	25	26.5	21.25		5.9	25	26.5	
5.4	29	30.5	20.5		5.10	25	26.5	26.5
5.5	29	30.5	22.5		5.11	28	29.5	
5.6	30	31.5	22.5		5.12	26	27.5	
6.1	31	32.5	28		6.5	30	31.5	
6.2	28	29.5			6.6	32	33.5	
6.3	25	26.5			6.7	28	29.5	
6.4	28	29.5			6.8	27	28.5	
13.1	22	23.5	21		13.5	25	26.5	
13.2	30	31.5	28		13.6	30	31.5	
13.3	28	29.5	17		13.7	29	30.5	
13.4	26	27.5			13.8	28	29.5	
14.1	25	26.5	24		14.5	24	25.5	
14.2	28	29.5	27		14.6	26	27.5	25
14.3	28	29.5			14.7	22	23.5	21
14.4	27	28.5	20		14.8	22	23.5	21
15.1	21	22.5			15.5	32	33.5	29
15.2	32	33.5	31		15.6	28	29.5	27
15.3	29	30.5	28.5		15.7	28	29.5	
15.4	29	30.5	29		15.8	27	28.5	

Figure 6 – HOV Services grade beam investigation.

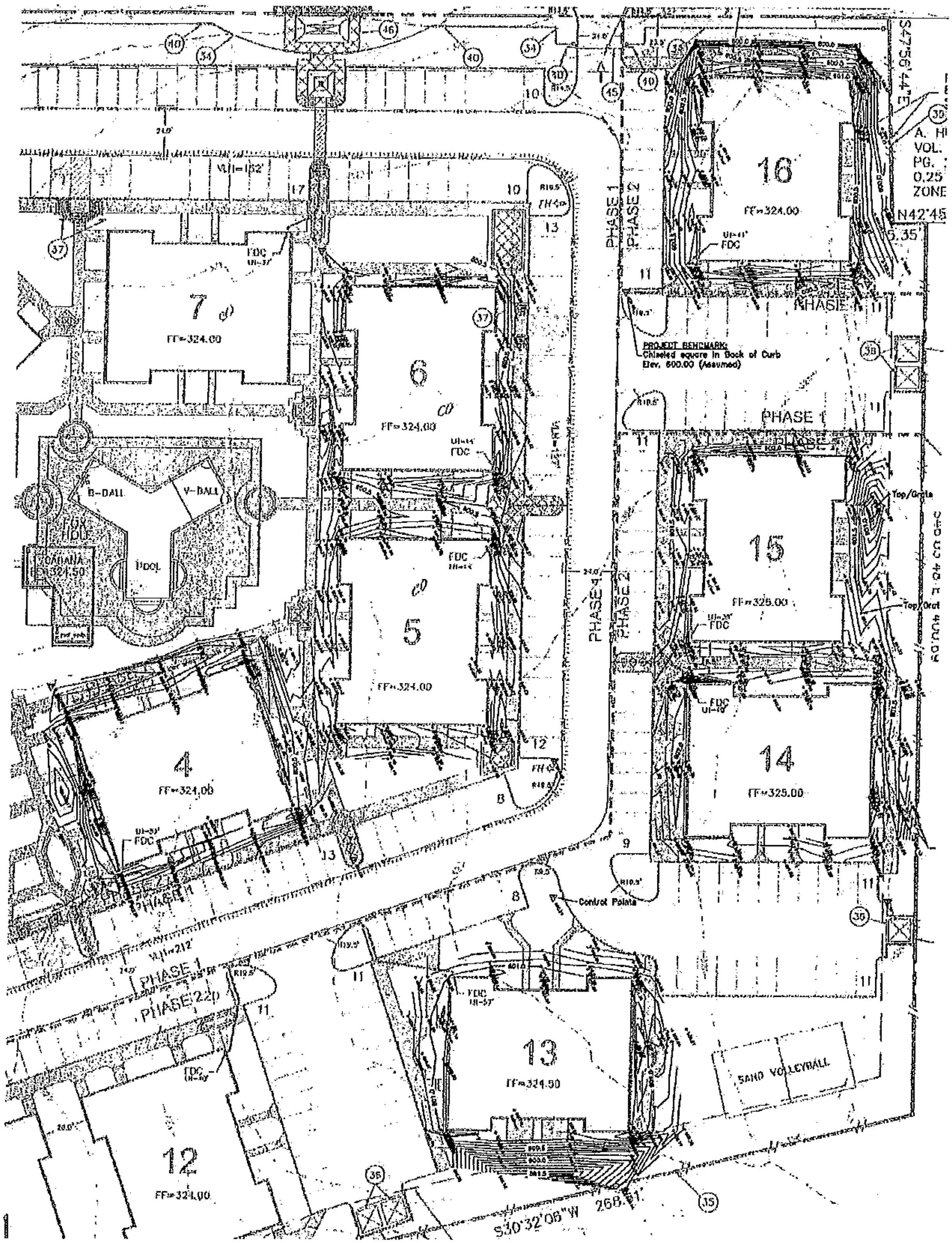

Figure 7 – McClure and Browne site topography.

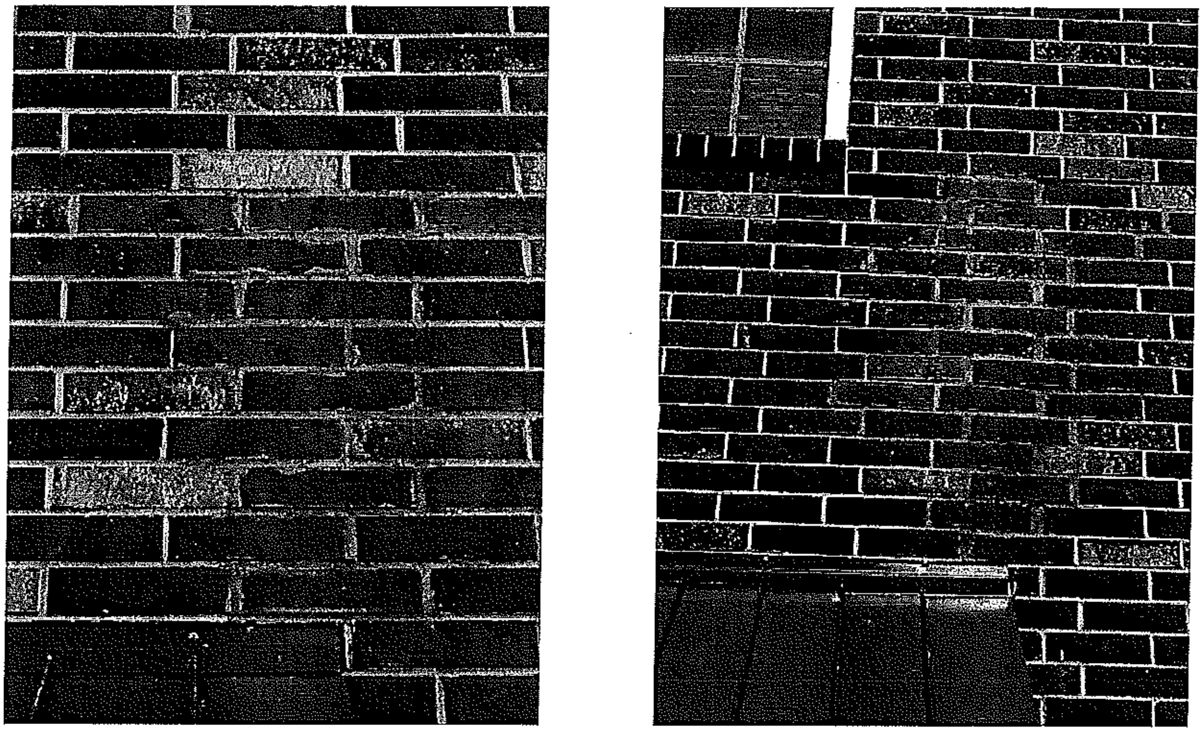

Figure 8 – Typical brick repairs (Bldg 14 left, Bldg 15 right).

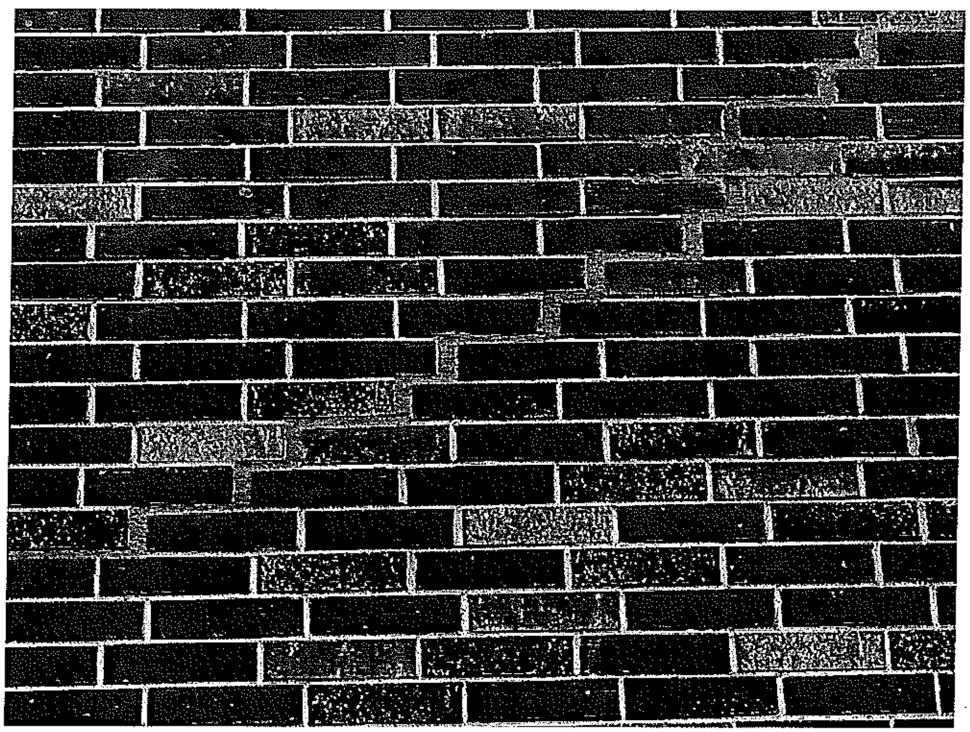

Figure 9 – Typical brick repairs (bldg 15).

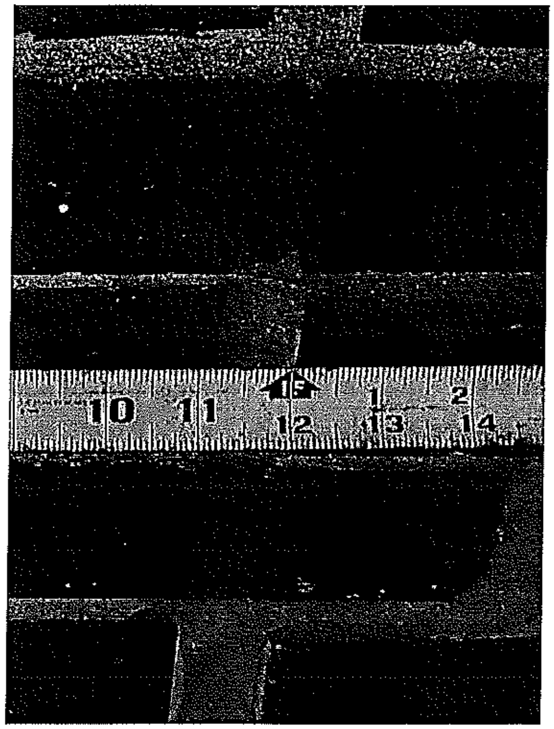

Figure 10 – Repaired mortar joint.

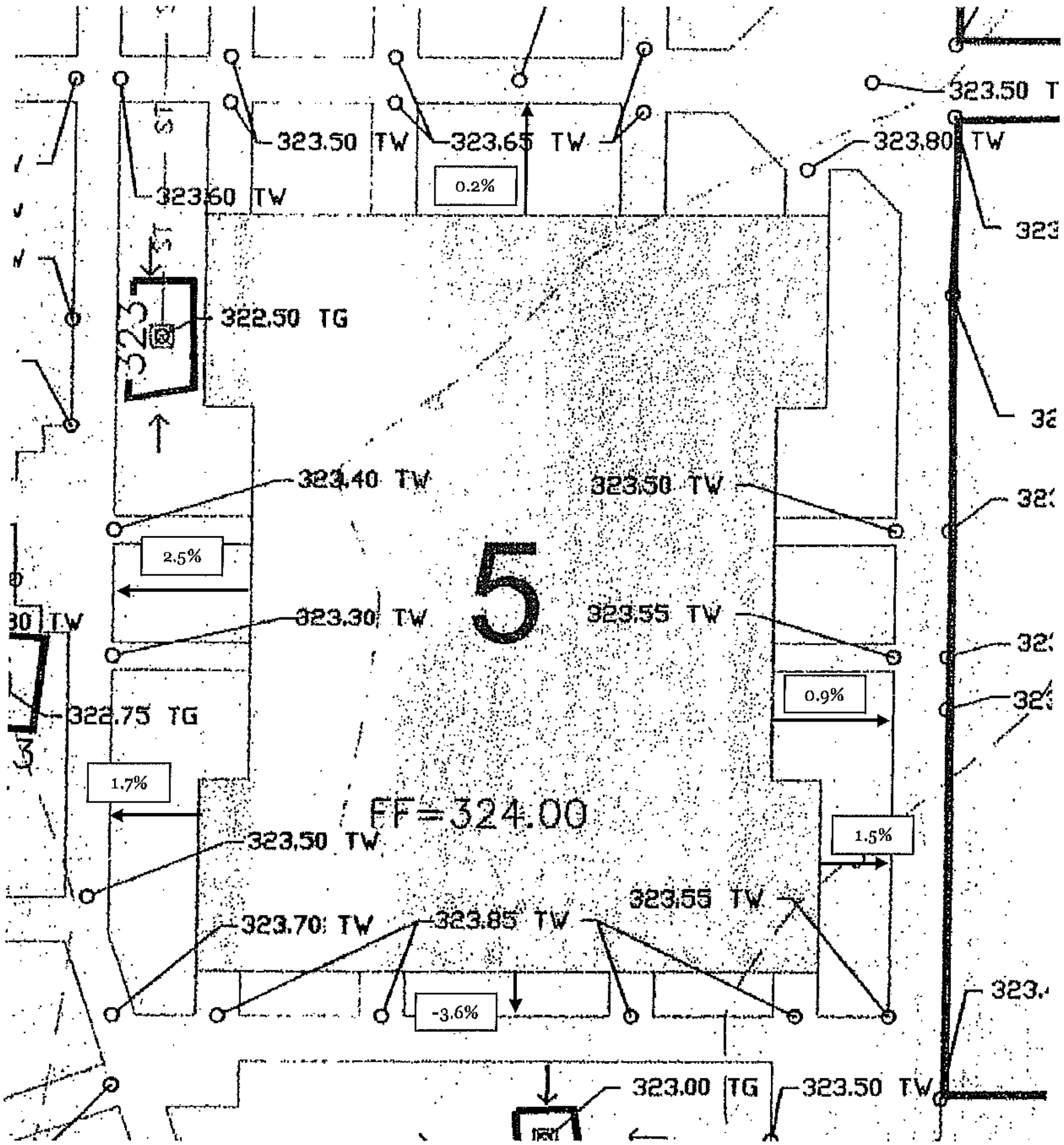

Figure 11 – Grading plan for Building 5.

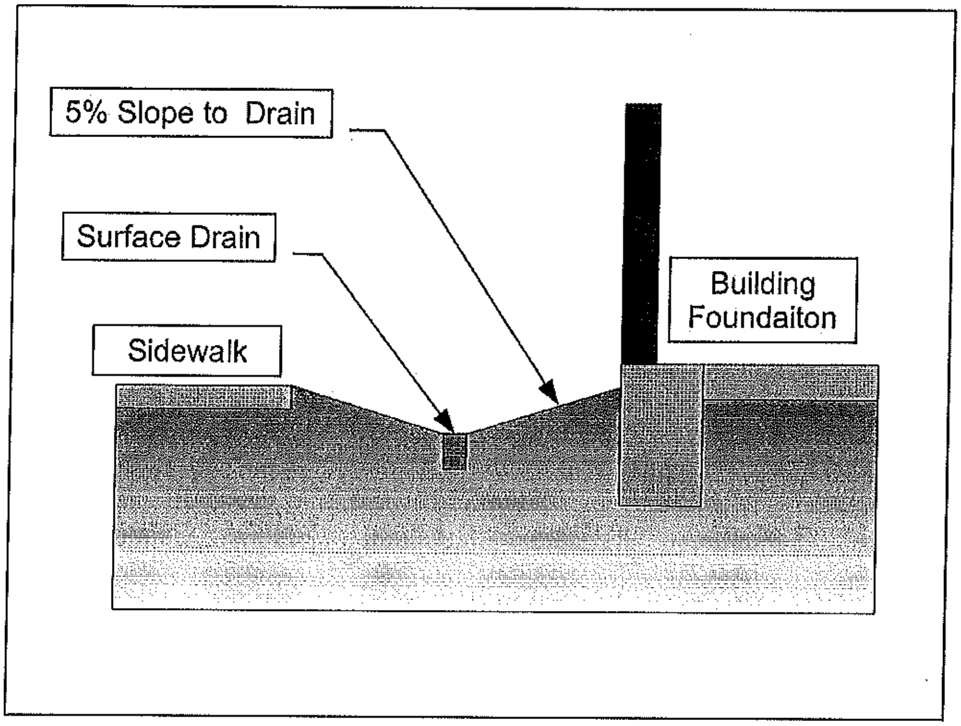

Figure 12 – Proposed remedial drainage.

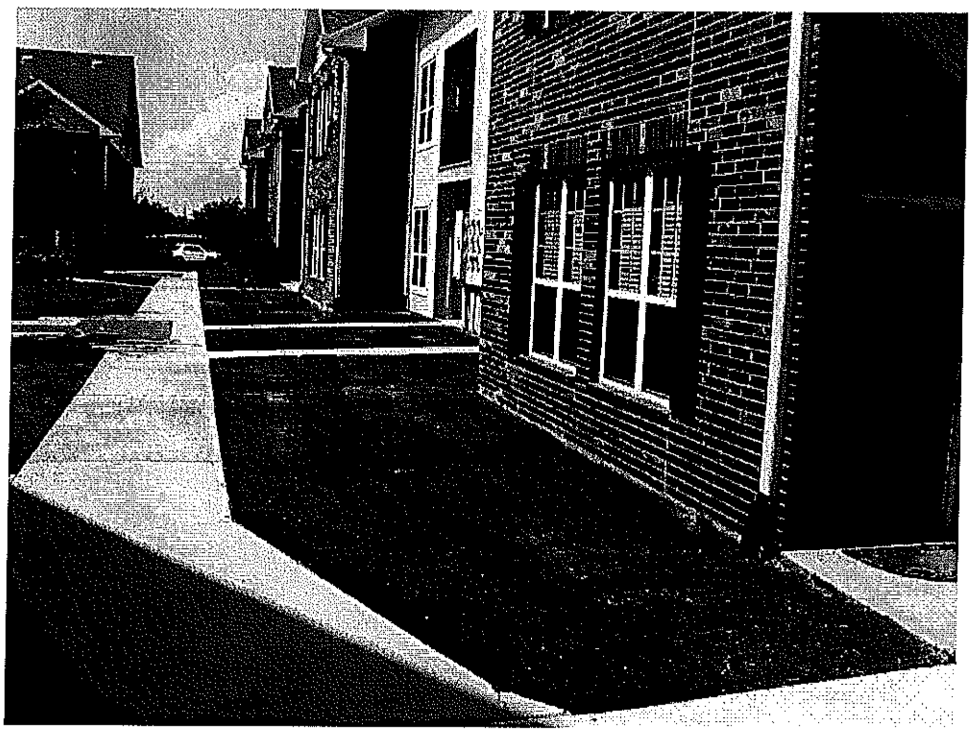

Figure 13 – Typical landscaping at Building 5.

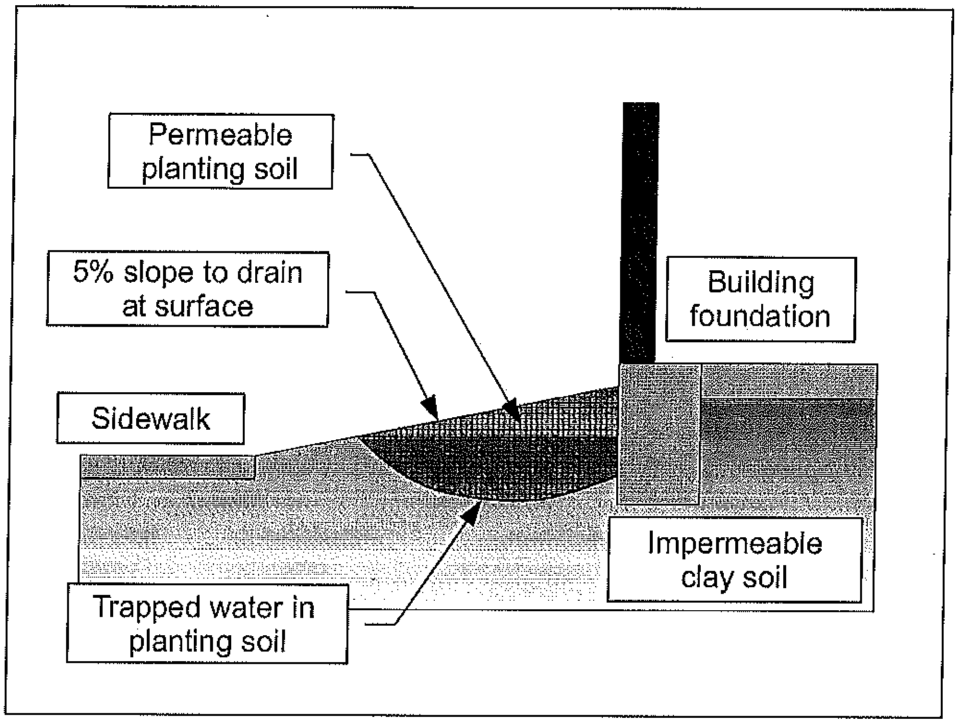

Figure 14 – Typical trapped drainage at planting beds.